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ABSTRACT

This paper reviews the literature on various types of grouping strategies in order to determine which is the most effective in influencing mathematics achievement. After discussing teachers' reasons for grouping and popular grouping strategies, specific research findings on these strategies are reported. Highlights of each grouping strategy are reviewed with recommendations for practice and further research. Grouping strategies discussed include: (1) long-term static groupings, such as homogeneous, heterogeneous, and within-class ability groupings; and (2) short-term flexible groupings, such as team-assisted individualized (TAI) instruction, cooperative learning; and situational grouping. Implications are suggested. Contains 17 references. (MKR)

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AN EXAMINATION OF GROUPING STRATEGIES AND THEIR EFFECT ON MATHEMATICS ACHIEVEMENT AT THE ELEMENTARY LEVEL

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The purpose of this review is to examine the various types of grouping strategies in order to determine which is the most effective in influencing mathematic achievement. After discussing teachers' reasons for grouping and briefly describing popular grouping strategies, specific research findings on these strategies will be reported. Finally, highlights of each grouping strategy will be reviewed with recommendations for practice and further research.

Background

Factors That Influence Decision To Group

Throughout the history of formal education, teachers have implemented, for a number of reasons, various grouping strategies to facilitate mathematics instruction. In her observational research study, Gerleman (1987) found that teachers' reasons for grouping were primarily to address individual student needs, and, to a lesser extent, because they either learned in college or through reading professional journals and books that grouping students is best for mathematics instruction. Good, Grouws, and Mason's (1990) research supported Gerleman's (1987) and found that most teachers chose to group in order to accommodate student diversity. Other factors that influence a teacher's decision to group include teacher preference to teach small numbers of students at a time; management purposes; skills to be covered, practiced or reviewed are conducive to small group instruction; or need for more personal peer interaction (Gerleman, 1987; Good et al, 1990). Although many factors may influence a teacher's decision to group, the research shows that the number one reason for grouping is to address students' varying needs and to promote more effective learning (Gerleman, 1987). Given that teachers group

students due to a variety of reasons already discussed, the focus of this paper will be on different ways to group students for mathematics instruction.

Definitions of Grouping Strategies

Long Term Static Groups

Long term static groups refer to groups that once set up remain in place for a long period of time (ie., the entire school year). They are static in that the composition of the group remains intact for the duration and change seldom occurs in the group for the academic year.

Homogeneous Whole Class Instruction refers to the organization of instructional classes on the basis of students' similarities and generally uses standardized measures of intelligence, aptitude or achievement in a given subject area as the criterion for classifying students. An entire grade that has been assessed for achievement in mathematics and grouped according to ability into a accelerated class, average class, or below average class, is considered to have been split into homogeneously grouped whole classes. During mathematics instruction, students relocate from their homerooms to another room with children of like abilities. This process is also termed "regrouping."

The Joplin Plan is a homogeneous whole class grouping strategy which involves grouping across grade lines and is generally associated with reading instruction. It is also called a "non-graded" or "ungraded" plan. A non-graded program groups students according to their performance not their age. The curriculum is divided into levels through which students progress each year from where they ceased the

previous year. For example, one homogeneous group may combine average ability fourth grade students and accelerated third grade students for reading instruction. In other words, the Joplin Plan involves homogeneous across grade grouping. The Joplin Plan relates to the topic of this paper because the researcher hypothesized that regrouping for reading would somehow influence mathematic achievement.

The Joplin Type Plan is a homogeneous whole class grouping strategy which involves grouping within one grade level for mathematics instruction. For example, at a third grade level all high ability students would be with one teacher, all average ability students would be with one teacher, and all low ability students would be with one teacher for mathematics instruction.

Heterogeneous Whole Class Instruction is an organization of instruction which reflects a rich mixture of children who differ in achievement. Heterogeneity may be achieved by either randomly assigning all children in a grade or school to an instructional class or by deliberately assigning children to instructional classes such that a wide range of individual differences is present. A whole class, heterogeneous model referred to in this paper is the Missouri Mathematics Program (MMP), an instructional program emphasizing a high ratio of active teaching to seatwork; frequent feedback; smooth transitions between activities; teaching mathematics in the context of meaning; management strategies intended to increase student time on task; and techniques derived from the practices of outstandingly effective traditional teachers (Good, Grouws & Edmeier, 1983).

Within Class Ability Grouping requires the teacher to assign students to small groups based on achievement, ability, speed of working, work habits and responsibility (Gerleman, 1987). Direct instruction is provided by the teacher to one group at a time while the rest of the class works independently. Materials vary from

group to group, making ability groups very static. Ability Grouping Active Teaching (AGAT) is a modification of this basic grouping strategy. AGAT emphasizes a high ratio of active instruction to seatwork; teaches math in the context of meaning; encourages frequent questions and feedback; implements management strategies that will minimize the management problem characteristic of ability-grouped instruction; and maintains high time-on-task (Slavin and Karweit, 1983).

Short Term Flexible Grouping

Short term flexible grouping refers to a type of grouping that is established to meet a specific educational need and which is dissolved once the goal has been met. Students are frequently reassigned to different groups throughout the school year. There are various kinds of short term flexible groupings. This paper will address individualized instruction, cooperative learning and situational grouping.

Team Assisted Individualization (TAI) is a programmed instruction model wherein students work on a sequential set of self-teaching materials at their own pace and instructional level. TAI uses the added component of cooperative learning teams to remedy the motivational and implementational problems associated with programmed instruction (Slavin, Leavey, and Madden, 1984). Students in the 4 to 5 member learning teams help one another with problems and take responsibility for almost all checking, routing and other management tasks inherent in an individualized program. The fact that students help one another allows the teacher to freely work with three smaller teaching groups composed of students performing at the same level in the materials. These materials consist of self-instructional units, answer sheets and tests for objectives in word problems and computational skills

that are used for 3 out of 4 weeks. At the end of each week students on teams that meet certain preset criteria receive attractive certificates. During the fourth week, the teacher teaches whole class lessons on objectives not covered by TAI materials. (Slavin & Karweit, 1985).

Cooperative Learning is a flexible grouping strategy which requires that a small group of students work interdependently in heterogeneous learning groups and are responsible for their own learning as well as that of their fellow group members. Students work cooperatively on a specific task which involves problem solving, investigating, and mastery of skills previously presented by the teacher.

Situational Grouping is a flexible, skill oriented grouping strategy. In a heterogeneous class, the teacher provides direct instruction to the whole class. Then, depending on students needs at that time, small remedial or enrichment groups are pulled.

In the following sections each instructional organization will be discussed separately to distinguish among them and to present the research examining them. A summary will follow that synthesizes the material.

Long Term Static Groups

Homogeneous Whole Class Grouping

Homogenous whole class grouping falls into this static grouping type because students in the same grade are reassigned to different classes for mathematics based on past ability and achievement, suggesting permanence by nature. The theoretical rationale for homogeneous grouping, not necessarily based on research findings, generally includes the following points: homogeneous grouping takes individual differences into account by allowing students to advance at their own rate with

others of similar ability, and by offering them methods and materials geared to their level; more individual attention from the teacher is possible; students are challenged to do their best in their group, or to be promoted to the next level, within a realistic range of competition; and it is easier to teach to and provide materials for a narrower range of ability. Because the different classes work from different materials and at different rates, changing from a higher class to a lower class is easier than moving from a lower class to a higher class. A number of research articles have been written about the homogeneous whole class grouping strategy for teaching mathematics. This review will look at Koonz' homogeneous grouping study, the Joplin Plan for reading and its influence on arithmetic achievement , the Joplin Type Plan for arithmetic instruction and a study examining district involvement.

Koontz (1961) hypothesized that children grouped homogeneously by subject matter achievement, and who were given instructional materials at their achievement level, would show no greater achievement than pupils who were grouped heterogeneously and followed a regular course of study. Upon entering fourth grade, students were put into homogeneous groups according to their Iowa test scores. The control pupils were grouped heterogeneously. At the conclusion of the academic year, using a post-test, Iowa test of Basic Skills, higher arithmetic achievement was achieved by the heterogeneous group, at all arithmetic levels. Overall, there were approximately three months difference in favor of this group. Here, as in many other studies, homogeneous grouping failed to realize its theoretical possibilities.

The Joplin Plan is another homogeneous grouping type with a cross grade component. Although Powell (1964) explored ten hypotheses in his research study

on The Joplin Plan, the one concerning arithmetic will be the focus for this paper. The hypothesis relating to math was that grouping for reading would somehow carry over and affect achievement in arithmetic as well. Powell (1964) believed that at the close of his study he would find no significant difference in arithmetic achievement between School A, which had been using the Joplin Plan in reading for 3.5 years, and School B, which utilized self contained classes for reading instruction (1964). The sample consisted of two similar groups of fourth, fifth and sixth grade students from two elementary schools in Indianapolis, Indiana. There were 164 participants from the Joplin Plan school and 207 from the school with self contained classes. A battery of achievement and ability tests were administered to students at both schools over a couple of months. Findings at the end of the study showed that there were, in fact, no significant differences on test performance in mathematics between the school using self contained classes for reading instruction and the school using The Joplin Plan. Powell (1964) suggested that research should not concentrate on the grouping which had no effect, but, instead, research should focus on the type of learning activities conducted in the classroom.

Davis and Tracy's (1963) study of The Joplin Type Plan, a homogeneous whole class grouping strategy without a cross grade component, sought to answer if this grouping strategy would increase student achievement in mathematics more so than a random, self-contained classroom. The sample in this study consisted of similar groups of fourth, fifth and sixth grade students from two elementary schools in North Carolina. School A's students were regrouped for mathematics instruction according to achievement and ability (Joplin Type Plan), while School B's students were randomly assigned to classes in their own grade at the beginning of the year. Achievement tests were administered to the students at the beginning and at the end

of the same school year. The results of this study demonstrated that for most, the Joplin Type Plan did not present an advantage over the self contained school in mathematics achievement. Davis and Tracy (1963) suggested that research needs to go beyond studying the grouping of students. The act of teaching should be addressed in order to aid students' achievement in mathematics.

The next study examined homogeneous grouping with a focus on district involvement. In 1991, Keller reported on the practice of student grouping in two substudies. The first substudy examined the performance of 176 high ability third through fifth graders in four Texas school districts including a continuous progress district. The continuous progress district provided a fully developed K-8 math scope and sequence, accompanying teaching strategies, availability of textbooks of any grade level, as needed, regardless of the student's physical grade level, a test bank to assess mastery, a computerized system to facilitate that assessment, and frequent meetings of personnel to review results for the regrouping of students and the replanning of instruction. The second substudy examined math performance of 223 lower ability fifth graders in four school districts also including a continuous progress district. The results showed that students involved in continuous progress districts consistently ranked at the top in areas of mathematics, computational skills and conceptual skills mastery. Despite these positive results, Keller (1991) suggested that the results were not due to the grouping plan used in the continuous progress district but to the fact that the district was committed to the plan.

Heterogeneous Whole Class Instruction

One of the most troublesome and enduring problems of mathematics instruction is accommodating heterogeneity in student preparedness and learning

rate. If students do not have the prerequisite skills to learn a lesson, or if they have already mastered the skills before the lesson or do so in the first minutes of the lesson, then instructional time is wasted (Slavin & Karweit, 1985). Three commonly proposed methods of dealing with student heterogeneity are individualized instruction (TAI), within class ability grouping (AGAT) and whole class instruction (MMP).

TAI, AGAT and MMP each were investigated in one study to determine their effects on mathematic achievement at the elementary level (Slavin & Karweit, 1985). Two substudies were involved. The first included a sample of 354 students in grades four through six from Delaware, where the districts had formed as a consequence of an extensive desegregation plan. This research was conducted for a period of over 18 weeks. The Mathematics Computation and Concepts and Applications subscales of the Comprehensive Test of Basic Skills (CTBS) were used to measure achievement. The results found that TAI and AGAT were nearly identical in mathematic achievement. The mathematic achievement results for both TAI and AGAT were substantially higher than MMP. The second substudy included 480 students in grades three through five from Western Maryland. This sample had a higher percentage of white students as compared to the first substudy. This experiment also added an untreated control group. AGAT and TAI showed superior results in computational achievement as compared to MMP; however, MMP demonstrated higher achievement results than the untreated control group (Slavin & Karweit, 1985).

There was a remarkable degree of commonality of findings regarding student achievement across the two experiments reported here. In both TAI and AGAT computational skills were markedly higher than MMP. Yet, the success of MMP

relative to the untreated control classes in the second experiment reemphasized the importance of active teaching and effective management strategies in the context of grouped paced instruction. In both experiments, TAI was associated with more positive student attitudes toward math class than MMP and AGAT (Slavin & Karweit, 1985).

An earlier study exclusively focused on MMP. The experimental program lasted four months and controlled for the Hawthorne Effect. During the course of the project 40 teachers were observed. Information was collected using a checklist (Good & Grouws, 1977). The checklist included implementation variables for both the experimental group (MMP) and the control group. The implementation variables for treatment included: content review, content development, homework check, mental computation, material summarization, student accountability for controlled practice during the development and seatwork phases, teacher demonstrations, seatwork with teacher availability, homework assignments, and short seatwork directions. The results found that the average student in the experimental group increased with his/her ability to answer questions correctly and received an impressively high percentile rank in terms of the national norms. The control group also showed gains but they did not match those of the experimental group. It is also important to note that these achievement increments were made in urban, low income schools. To summarize, the results of this study suggested using MMP in a heterogeneous classroom because of its active teaching and frequent interactions with students (Good & Grouws, 1977).

Peterson (1989) directed a research study that compared the effects of different math programs on similar students. This study involved seventh graders from three Utah school districts. All students were in the same math classes for the entire year.

Three hundred seventh grade students were selected from each district, 100 remedial, 100 average and 100 accelerated, as determined by scores on the California Test of Basic Skills from the end of the previous school year. These groups were also matched according to IQ. Three heterogeneous groups were established. Group A students spent the entire year studying mechanical skills that they had been taught but had not mastered. No concepts beyond the standard expectations for sixth grade were presented. Group B students studied the standard seventh grade math text but moved through it at a slower pace than the average student. This included 30% mechanics and 70% problem solving. Group C students spent the entire year in pre-algebra designed for accelerated students. All students received the same program at the same pace, with no ability grouping or identification of remedial students in the records.

Peterson (1989) found that remedial students in the pre-algebra program designed for accelerated students showed more improvement than remedial students in either of the other programs. While many of these students did not learn a great deal about mathematical concepts and pre-algebra, they learned arithmetic and problem solving skills indirectly by using them in pre-algebra. In fact, they learned these skills more effectively than did those student who spent the entire school year studying them directly.

Remedial students in pre-algebra were in classes where most of the students participated, asked questions, and seemed to enjoy mathematics. The teaching mode involved more discussion and discipline problems were minor and infrequent as compared to the other groups. Of the 100 students in the accelerated program, end of the year achievement tests placed 17 remedial students in the "average"

category and 2 remedial students in the "accelerated program." Not one remedial student in the other two programs was able to advance to a higher category.

Peterson (1989) observed that while ability grouping may help some students, it hurt remedial students. Once a student was placed in a remedial mathematics program, which moved at a slower pace using different instructional materials, it was unlikely that the student would ever return to the regular classroom. These remedial students asked fewer questions, showed little interest in mathematics and reinforced each others negative attitudes towards math. This was true even when the student who belonged in a higher group was misplaced in a remedial program.

Peterson (1989) concluded that if schools used ability grouping, they should ensure that all tracks use the same basic materials and should move at the same pace to allow students to transfer from one track to another when appropriate. Advanced tracks should cover the material more deeply. If there is a remedial track, it should be taught by the best teachers available and in classes small enough that individual help can be given. The difference should be in the attention given rather than in the subject matter taught.

In a paper presented to the 1987 Annual Meeting of the American Educational Research Association, Butler et al. reported on a comparative study of student achievement in the area of reading and mathematics of 186 homogeneously and heterogeneously grouped second graders from East Central Mississippi. This research examined whether a difference existed in achievement depending upon the type of grouping in which the child was involved. In addition, this research attempted to identify and/or explore differences in time on task for each group.

Students were stratified into low, medium, and high achievement groups based on their achievement scores at the end of first grade. They were then randomly

assigned to either a homogeneous or a heterogeneous classroom. The resulting eight classroom groups consisted of two heterogeneous groups, two lower achieving homogeneous groups, two middle achieving homogeneous groups, and two high level homogeneous groups. The eight teachers who participated were randomly assigned a group of children.

The children were then taught reading and mathematics as outlined in the schools curriculum, using the same materials and instructional studies for all groups. During the first two months, trained observers determined the average time on task exhibited by individual children. The Stanford Achievement Test Battery, Primary 2, Form E was administered in April to determine students' achievement.

Focusing on math data only, the results showed that there were no significant differences in overall achievement between second graders taught in homogeneous or heterogeneous groups in mathematics. There were no significant differences found in time on task between homogeneous and heterogeneous grouped students who were placed in the upper academic group. However, lower and middle achieving students both stayed on task longer in the homogeneous groups. Finally, time on task for second graders in homogeneous groups correlated significantly with their achievement. This relationship was not observed for children in heterogeneous groups.

The results of Butler's et al. (1987) study were contrary to other research findings reported in this review. Butler et al. (1987) concluded that the rationale for encouraging heterogeneous grouping had been that children achieve just as well as they do in homogeneous groups, and they avoided the negative attitudes associated with ability grouping.

Within Class Ability Grouping

Dewark (1963) conducted a research study on a 3-group organizational model (high, medium, low) within the classroom to determine whether pupils who received instruction in arithmetic on their level of achievement would show significantly better achievement than pupils who received instruction at that particular grade level by the traditional whole class organization. The suburban, upper-middle class students and their teachers were randomly assigned to control and experimental groups. The 3-group organization that made up the experimental classes were allotted specific times for instruction and assignment. The Stanford Achievement Test and the Lorge-Thorndike Intelligence Tests were administered.

Data analysis revealed that the high and low groups gained significantly over their respective control groups in level of confidence. The mean gain in achievement for all experimental groups was greater than the control groups, but a significant analysis was not conducted. The conclusion from the statistical evidence stated that this type of organization, a 3-group model, benefited the high achieving and the low achieving groups in the population studied.

In a more thorough and intensive study by Slavin and Karweit (1985), it was stated that the purpose of different grouping programs was to reduce classroom heterogeneity so that student's needs could be more efficiently met. Ability Grouped Active Teaching (AGAT) was developed for that study as a means of applying the main principles of the MMP to an ability-grouped method (Slavin & Karweit, 1985). On the basis of the initial test, students in each AGAT class were divided into a high group and a low group.

In Experiment 1, AGAT and TAI's achievement results were higher than MMP. In Experiment 2, all three experimental conditions, AGAT, MMP and TAI, exceeded the untreated control group.

The success of the AGAT program was more surprising due to the strength of its findings. While previous research on within-class ability grouping has found more positive than negative effects of this practice on student achievement, these effects have not been strong nor consistent (Begle, 1975). The substantial positive effects of AGAT seen in present studies may be due to the specific method of implementing within class ability grouping which specified class management strategies derived from the work of Anderson, Evertson, and Brophy (1979) and Clements and Evertson (1982) as cited in Slavin (1985). It should be noted that following the study, none of the AGAT teachers continued to use the program. AGAT was unpopular because 88% of the AGAT teachers felt that AGAT required more work from their usual methods (Slavin, 1985). AGAT was the only long term static group that produced a positive effect on student achievement in mathematics. More success was evident with short term flexible grouping strategies.

Short Term Flexible Grouping

Within Class Ability Grouping

Small group ability grouping also known as "within-class ability grouping" is associated with enhanced achievement in mathematics when students are frequently reassessed and reassigned to new groups based on their performance. This conclusion, reported by Brophy (1986) about Slavin's (1986) research was based on the results of five brief studies, lasting no longer than one semester, and conducted at the intermediate level. The five studies involved subdividing classes into only two

or at the most three groups so that the management was less complex and the students received more direct instruction from the teacher. Slavin (1986) suggested that there may be relatively more benefits associated with within class grouping in mathematics than most other subject areas because math curricula involves a hierarchical sequencing, and more is to be gained by grouping for instruction in specific content. Additionally, because extensive work on practice and application exercises appeared to be essential to the mastery of mathematics, it was likely that the assignments given to students to work on during seatwork would be substantially important and essential to their progress. Within class grouping may be worth considering for intermediate level mathematics, especially in highly heterogeneous classes; however, care should be taken to keep assignments flexible (Brophy, 1986).

Team Assisted Individualized Instruction

Team Assisted Individualized Instruction (TAI) is a short term flexible grouping strateg· 'n that cooperative learning is utilized but the emphasis is on individualized learning with students helping their teammates. All of the research reviewed here concerning TAI has been conducted and reported by Slavin and others.

In 1984, Slavin, Leavey, and Madden reported research findings on their attempt to remedy the problems of programmed instruction by adding an additional component of cooperative groups. Attitudes and behaviors were also studied, and the results were reported. The researchers conducted two studies. One study included a total of 504 students in grades three, four and five, from six schools in a middle-class suburban Maryland school district. The students were randomly assigned to one of three groups, TAI, individualized instruction without teams, or a

control group. In the second study, a total of 375 students participated in the study from grades four, five and six. Four schools were involved in the study: one TAI school and one control school were middle to lower class while the other TAI school and control school were primarily lower class. The second study did not assign any students to a third, individualized instruction group without teams as the first study did. Pre and post tests were administered to all groups at the beginning and at the close of the study. In Study 1, results indicated no significant differences between the TAI group and the individualized instruction group; however, both groups demonstrated more positive results than the control group in mathematic achievement, liking of math class, self concept in math, amount of behavior problems, friendship problems and negative peer perceptions. In Study 2, the TAI groups exceeded the control group significantly in mathematics achievement. There were no significant differences on the liking of math class, self concept in math, behavior problems or negative peer perceptions. Some conclusions could be drawn from these studies. First, TAI supported the hypothesis that this method of instruction increased student achievement in mathematics more than traditional group-paced instruction. Second, although there were no significant differences in Study 1 between TAI and individualized instruction groups, the differences between TAI group and control group were larger than those in the individualized instruction group. Teachers who tried both approaches preferred TAI because having team members to field questions from peers reduced the number of questions teachers had to answer. Lastly, it was evident by this study that all students achieved best when given instruction that matched their own pace in mathematics.

TAI was a program that meet this need and could be managed by one teacher and no assistants (Slavin, Madden & Leavey, 1984).

These findings were supported by the quasi-experimental study by Slavin Madden, and Leavey (1984) in which TAI was used with handicapped and nonhandicapped students. This experiment by Slavin et al. (1984) was implemented over a 24-week period. The results yielded highly significant treatment effects in favor of TAI classes for math concepts, and applications, as well as computations. For both subgroups, handicapped and nonhandicapped students, TAI students learned significantly more than untreated control students in a traditional classroom on both achievement measures. The TAI was positively favored as compared to a traditional math method. The TAI strongly suggested that although it was important to meet the needs of academically handicapped students, it was not anymore important than meeting the unique and diverse instructional needs of every student (Slavin et al., 1984).

Cooperative Learning

Slavin (1983) conducted extensive research on cooperative learning methods and the effect they had on student achievement. Forty six studies were included in his work. Cooperative learning methods used in classrooms, always involved cooperative tasks, but not all of them involved cooperative incentives. Tasks came in two varieties: task specialization, in which each group member was responsible for a unique part of the group activity, and group study, in which all members studied together but did not have separate tasks. The critical feature was that two or more individuals were interdependent for a reward they would share if they were successful as a group.

Slavin (1983) was able to categorize cooperative learning into six different grouping methods. The first three categories were: Group Study with Group Reward for Individual Learning, Group Study with Group Reward for Group Product, and Group Study with Individual Reward. These groups required students to work together in small groups on worksheets or to review other information initially presented by the teacher. The second three categories were: Task Specialization with Group Reward for Individual Learning, Task Specialization with Group Reward for Group Product, and Task Specialization with Individual Reward. In these groups students were given a unique topic or task on which to become an "expert" and then taught the other members of the group about what they had learned.

Slavin (1983) reported that taken together, the effects on cooperative learning methods on student achievement were clearly positive. The extent of the positive effects of task specialization methods on student achievement depended on the use of group rewards, regardless of whether or not the research was based on individual learning or group performance. Results of group study showed that the opportunity for students to study together made little or no contribution to the effects of cooperative learning on student achievement unless the teacher provided further structure in the form of individual assessment and group reward.

Slavin (1983) concluded that among cooperative learning methods in which students studied the same material together, methods that provided group rewards based on group members' individual learning consistently increased student achievement. Cooperative learning methods in which each group member had a unique subtask had the highest positive achievement effects when group rewards were provided. Group rewards and individual accountability were held to be

essential to the instructional effectiveness of cooperative learning methods. Cooperative learning, a short term flexible grouping, enhanced student achievement in mathematics especially when individual accountability and group rewards were utilized.

Small Group Learning and Cognition

Sharan, Ackerman and Hertz-Lazarowitz (1979) researched small group instruction versus whole class instruction and its effects on cognitive functioning and student achievement. In this study, all the students in ten classrooms from two comparable elementary schools were involved. Students were in grades two through six. One school used small group teaching practices and the other used traditional whole class instruction. In this study, the researchers examined whether students who engaged in small group learning performed better than those involved in traditional classrooms in cognitive functions. Low level cognitive functions emphasized information acquisition, memory and understanding. High level cognitive functions included investigation and discussion.

Sharan et al. (1979) reported in three out of five grade levels, children who studied in small groups received higher scores on the high level questions than did pupils from traditional classrooms. Data on low level questions were mixed. Pupils in the second grade small group classrooms excelled on these questions as well as on the high level ones. Fifth graders in the small group classrooms scored well on the low level questions. Fourth and sixth grade pupils in traditional classrooms scored better on low level questions.

Sharan et al. (1979) concluded that small group learning with pupils cooperating in the study of academic subject matter can lead to superior achievement involving

higher order thinking over whole class instruction. The findings also found that small group and traditional classroom learning did not really differ in their effects on the learning that required thinking at lower levels of Bloom's taxonomy. Participants in small groups also showed better attitudes about school and higher levels of involvement in their work. In short, it appeared that small group learning was an effective alternative to traditional presentation and recitation teaching and learning, and it stretched the students to use high order thinking skills.

Situational Grouping

Another short term flexible type grouping is situational grouping. Mason and Good (1993) presented the effects of two models of active teaching and active learning on the mathematic achievement of 1,736 fourth, fifth and sixth grade students in 81 classrooms in which teachers used within grade regrouping. Students were first assigned to teachers by a homogeneous structure. They were regrouped in math to increase homogeneity even more. Teachers again regrouped students in their rooms into two ability groups using the two different models. The first model provided for student diversity through situational remediation and enrichment grouping on a daily basis with small groups. The second model was a 2-group model that accommodated diversity through long term within class ability groups. There were nine schools from a midwestern district that were matched and randomly assigned to treatment conditions. Treatment teachers were thoroughly trained in the active model of situational grouping. Observations and videotapes of small group teaching were made to make sure correct components of teaching were being used.

The results showed very positive effects towards situational grouping. This approach had thorough and meaningful lesson developments and a better quality of assessing student's understanding. In addition, achievement among students in situational groups was significantly higher than in the control classes (Mason & Good, 1993).

In conclusion, the situational grouping model in this study proved to be more interesting and more adaptable than the 2-group model. Results indicated that teachers and principals should be careful about assigning students to long term within class ability groups for math and that homogeneous, within grade regrouping and situational grouping provided students more challenging material, better instruction and a more active learning environment. Finally, situational grouping, because of its flexibility, would most likely be successful even without the additional regrouping which occurred in this study (Mason & Good, 1993).

Conclusions

The research presented in this literature review focused on long term static grouping and short term flexible grouping strategies. Specific findings for each grouping style included both positive and negative results, but, generally, short term flexible grouping was favored.

With long term static grouping, findings supported the conclusion that unless the school district was totally committed to whole class homogeneous groupings, this grouping strategy did not enhance student achievement in mathematics. In fact, the homogeneous group studied by Koontz (1961) trailed the control group in math achievement by three months. The results of the Joplin Plan study found that

regrouping homogeneously for reading instruction had no significant effect on math achievement. Regrouping homogeneously for math instruction as in the Joplin Type Plan exhibited no advantage over the traditional classroom instruction as well.

More positive results were found with heterogeneous whole class instruction. The Missouri Mathematics Project (MMP) was found to be more effective than traditional classroom instruction because it reemphasized the importance of active teaching and effective management strategies. Peterson (1989) found that many remedial students when placed in an accelerated math program made gains such that they were no longer considered remedial. In conclusion, the rationale for encouraging heterogeneous groupings has been that children achieve just as well as those children placed in homogeneous groupings and avoid the negative attitudes that are associated with ability grouping.

Research findings on within class small group ability grouping tended to be varied and mixed. Some research suggested that long term static ability grouping benefited the high achieving students and the low achieving students. Ability Grouped Active Teaching (AGAT), another form of static ability grouping, demonstrated superior results in achievement as compared to MMP. The AGAT strategy required more preparation than usual grouping methods, so many teachers did not continue using this plan.

Brophy (1986) asserted that while ability grouping may be worth considering for highly heterogeneous math classes, group assignments should be kept flexible. This literature review examined several short term grouping strategies including Team Assisted Individualization (TAI), cooperative learning and situational grouping. TAI was positively favored as compared to the traditional math methods. Cooperative learning enhanced student achievement in mathematics especially when

individual accountability and group rewards were utilized. Sharan (1979) reported that students engaged in learning cooperatively tended to use higher order thinking skills more often. Situational grouping provided students more challenging material, better instruction, and a more active learning environment. These small, flexible grouping strategies clearly showed a positive effect on math achievement.

In summary, research findings supported the benefits of short term flexible grouping by producing more desirable effects on mathematics achievement and attitudes. On the other hand, long term static grouping should be avoided unless the district and the teachers are totally committed both financially and philosophically.

Recommendations for Practice and Further Research

The combined results of these studies should have an impact on the way teachers group for math instruction. Recognizing that teaching is a science and an art, it is difficult to select one grouping strategy for the teaching of mathematics; however, certain grouping strategies demonstrated better results than others. This paper has shown that teachers group primarily to address academic diversity in the classroom. Several grouping strategies have proven to be effective in achieving this end. They include Ability Group Active Teaching (AGAT), Team Assisted Individualization (TAI), Cooperative Learning and Situational Grouping. Except for AGAT, long term static groups were not supported by the research. While AGAT produced positive results in achievement, caution should be taken when considering this grouping strategy because teachers involved in this study did not continue using AGAT due to the excessive amount of work required. Ability groups, in general, should be formed according to performance of a specific skill, not merely student

achievement based on standardized measures. They should be limited to two or three groups, allowing teachers to give better instruction to each group. They should be adapted to the students' needs, and group assignments should be kept flexible (Slavin, 1986 and Brophy, 1986). For teachers who prefer an individualized program of instruction, TAI will help them meet their goals. Cooperative learning has proven to be an effective method of grouping students and may be used in the classroom either consistently or intermittently especially for problem-solving, skill practice, and investigative activities. However, it is important that teachers first provide instruction in processes and social skills. Possibly the easiest grouping strategy to implement that has proven to be effective in increasing students' mathematic achievement is situational grouping. This method of grouping allows teachers to repeat direct skill instruction for only those students who require it. Teachers are also free to group for enrichment purposes, thereby, addressing student needs at either end of the spectrum.

Four grouping strategies emerged from this literature review as having a positive effective on mathematic achievement, however, further research is needed comparing TAI, AGAT, Cooperative Learning, and situational grouping to each other in order to determine which, if any, is superior. In addition, research should investigate grouping strategies at primary and intermediate levels due to the hierarchical skills of mathematics.

Grouping by itself may be limited in scope. Several researchers (Davis & Tracy, 1963; Powell, 1964; Slavin & Karweit, 1985) voiced concern that teachers' instructional methods, teacher ability, materials, and curriculum could have a

greater impact on student achievement than the grouping strategy used. This needs to be investigated. In addition, characteristics of the child (i.e., self-esteem) could be an important factor. Careful studies need to be established to explore these possibilities as well.

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